EP1350869

Publication Title:

Improved binder fiber and nonwoven web

Abstract:

The present invention comprises a binder fiber containing a metallocene catalyzed polyethylene (mPE) and an adhesion promoter. A web comprising the binder fiber and absorbent is also contemplated. The present invention also comprises a binder fiber containing polyolefin, an adhesion promoter, and an enhancement agent. The polyolefin may be polypropylene, high density polyethylene, medium density polyethylene, low density polyethylene, linear low density polyethylene, or ultra low density polyethylene, ma
35d
nufactured with either Ziegler-Natta or metallocene catalysts. A web comprising this binder fiber and absorbent is also contemplated. The adhesion promoter may be maleic anhydride grafted polyolefins, or ethylene-acrylic copolymers, or a combination of these. The enhancement agent may be one or more of titanium dioxide, talc, silica, alum (aluminum sulfate), calcium carbonate, and magnesium oxide.

----

(19) Europäisches Patentamt
European Patent Office
Office européen des brevets

(11) EP 1 350 869 A1

(12) EUROPEAN PATENT APPLICATION

(43) Date of publication:
08.10.2003 Bulletin 2003/41

(21) Application number: 03006296.2

(22) Date of filing: 24.03.2003

(51) Int Cl.7: D01F 8/00, D01F 8/14, D04H 1/00, D04H 13/00, A61F 13/00

(84) Designated Contracting States:
AT BE BG CH CY CZ DE DK EE ES FI FR GB GR HU IE IT LI LU MC NL PT RO SE SI SK TR
Designated Extension States:
AL LT LV MK

(30) Priority: 05.04.2002 US 370163 P
02.05.2002 US 137157

(71) Applicant: ARTEVA TECHNOLOGIES S.à.r.l.
8001 Zürich (CH)

(72) Inventors:
- Pittman, Ida L.J.
Jamestown, North Carolina 27282 (US)
- Latten, Paul L.
Huntersville, North Carolina 28078 (US)
- Lin, Tingdong
Mooresville, North Carolina 28117 (US)

(74) Representative: Schweitzer, Klaus, Dr. et al
Patentanwaltskanzlei Zounek,
Industriepark Kalle-Albert,
Gebäude H391
Rheingaustrasse 190-196
65174 Wiesbaden (DE)

(54) Improved binder fiber and nonwoven web

(57) The present invention comprises a binder fiber containing a metallocene catalyzed polyethylene (mPE) and an adhesion promoter. A web comprising the binder fiber and absorbent is also contemplated. The present invention also comprises a binder fiber containing polyolefin, an adhesion promoter, and an enhancement agent. The polyolefin may be polypropylene, high density polyethylene, medium density polyethylene, low density polyethylene, linear low density polyethylene, or ultra low density polyethylene, manufactured with either Ziegler-Natta or metallocene catalysts. A web comprising this binder fiber and absorbent is also contemplated. The adhesion promoter may be maleic anhydride grafted polyolefins, or ethylene-acrylic copolymers, or a combination of these. The enhancement agent may be one or more of titanium dioxide, talc, silica, alum (aluminum sulfate), calcium carbonate, and magnesium oxide.

Printed by Jouve, 75001 PARIS (FR)

Description

[0001] The present invention relates to a binder fiber which has improved adhesion with absorbent materials particularly at temperatures below about 140°C. The binder fibers can be in the form of low melting fibers or bicomponent fibers. Either of these fibers (or a mix of these fibers) can be used with absorbent material to create a nonwoven web. The improved binder fibers have improved adhesion at temperatures below 140°C compared with current commercially available improved adhesion fibers. Such fibers enable the user to achieve the ideal thermal bonding at faster throughputs. An increase in the z-directional web strength (thickness) for higher basis weight webs permits the incorporation of additional heat sensitive raw materials heretofore unusable, while retaining thermal bonding efficiency. Webs made from the binder fibers of the present invention are useful in diapers, incontinent pads, sanitary napkins and other absorbent pads for liquids.

[0002] Nonwoven webs particularly in the form of disposal absorbent articles such as disposable diapers have had much success in the marketplace. However, there is always a need to improve these products and particularly in terms of their adhesion such that they do not fall apart during manufacturing, processing into articles, and during use. Prior to the present invention, it was known to form nonwoven webs from wood pulp (and optionally up to 25% by weight super absorbent polymer, SAP), and a binder such as a bicomponent fiber or a low melting polymer fiber. These existing compositions contained approximately 10% binder and approximately 80 to 90% by weight wood pulp (and optionally SAP).

[0003] These nonwoven webs were first created by mixing the wood pulp (and optionally SAP) with the binder. This composition was then introduced into a heating zone, such that the lower melting material of the polymer, or the lower melting material of the bicomponent fiber would melt and coat at least a portion of most of the wood pulp fibers (and optionally SAP). The composition was then introduced into a cooling zone where the lower melting binder material would solidify thereby binding the wood pulp (and optionally SAP) into a unitary web structure.

[0004] Optionally, other fibers may be introduced such as other synthetic fibers or natural fibers to achieve other desired characteristics such as low density, high loft, compression resistance, and fluid uptake rate.

[0005] US-A-4,950,541 and US-A-5,372,885 disclose the use of maleic acid or maleic anhydride grafted polyethylene. These fibers are the commercially available conventional fibers which the present invention improves or is an improvement thereover.

[0006] US-A-5,981,410 discloses bicomponent fibers blended with cellulose fibers such as pulp fibers or cotton fibers to create a nonwoven web useful in disposable diapers, for example.

[0007] US-A-5,994,244 discloses a nonwoven web comprised of cellulose type fibers such as fluff pulp and low melt fibers useful in producing disposable diapers, among other things. It also discloses the addition of inorganic particle (e.g. TiO_2) to the ethylene-acrylic-ester maleic anhydride sheath bicomponent spunbond filament. The particles reduce the adhesion of the filaments during spinning and give a more uniform web.

[0008] US-A-5,126,201 discloses the addition of TiO_2 in both the core and sheath of bicomponent binder fibers to improve the cutting efficiency of nonwoven webs. The amount of TiO_2 in the core is >1.5 wt.-%, preferably there is no TiO_2 in the sheath, since TiO_2 in the sheath reduces adhesion.

[0009] JP-A-02-169718 discloses polyolefin sheath/polyester core bicomponent fibers, the sheath containing 0.3-10 wt.-% of inorganic particles (preferably TiO_2) to obtain a better softness and opacity of the web. This document teaches that the addition of inorganic particles reduce the nonwoven web strength.

[0010] Despite the improvement that US-A-4,950,541 and US-A-5,372,885 give to nonwoven webs relative to improved adhesion strengths, there is still a need to improve the adhesion of nonwoven webs, and particularly, using lower processing temperatures. There is a need to increase the throughput or production without effecting thermal bonding efficiency. There is also a need to increase the z-directional web strength (the thickness) of thicker webs having higher weights. Lastly, there is a need in the art to retain thermal bonding efficiency but lower the processing temperature such that additional heat sensitive raw materials can be employed in the production of nonwoven webs, such as antimicrobials, deodorants, and fragrances.

[0011] The present invention is an improvement over existing nonwoven web products using the binding fibers disclosed in US-A-4,950,541 and US-A-5,372,885 mentioned previously. In particular, the present invention improves the adhesion of nonwoven webs by using the binder fibers of the present invention. The binder fibers of the present invention have a lower thermal bonding temperature and therefore the throughput or production can be increased by maintaining the oven at its operating temperature and increasing the line speed of the webs through the oven. Alternatively, one could lower the processing temperature so that additional heat sensitive raw materials could be incorporated into the web without affecting the thermal bonding efficiency. Lastly, oven temperatures could be maintained and thicker webs could be produced by using the binder fibers of the present invention without slowing the production line speed, since the binder fibers of the present invention have a lower melting point than those commercially available.

[0012] The binder fibers of the present invention can either be in the form of low melt fiber, bicomponent fiber, or both. The low melt portion of the bicomponent fiber would comprise the same material as the low melt fiber. The low

melt fiber and the low melt portion of the bicomponent fiber are made from polyolefin and are referred to as "base polyolefin". Base polyolefin does not include any polyolefin in the high melt component of bicomponent fiber. The preferred binder fiber of the present invention is the bicomponent fiber.

[0013] In the broadest sense, the present invention comprises a binder fiber containing a metallocene catalyzed polyethylene (mPE) and an adhesion promoter. The adhesion promoter may be maleic acid or maleic anhydride grafted polyolefins, or ethylene-acrylic copolymers, or a combination of these.

[0014] In the broadest sense, the present invention also comprises a binder fiber containing base polyolefin, an adhesion promoter, and an enhancement agent. The base polyolefin may be polypropylene, high density polyethylene, medium density polyethylene, low density polyethylene, linear low density polyethylene, or ultra low density polyethylene, manufactured with either Ziegler-Natta or metallocene catalysts. The adhesion promoter may be maleic anhydride grafted polyolefins, or ethylene-acrylic copolymers, or a combination of these. The enhancement agent may be one or more of titanium dioxide, talc, silica, alum (aluminum sulfate), calcium carbonate, and magnesium oxide.

[0015] In the broadest sense, the present invention also comprises a web made with the binder fibers of the present invention and absorbent.

[0016] Figure 1 compares the bonding index as a function of bonding temperature of the inventive binder fiber compared to prior art binder fiber.

[0017] Binder fibers of the present invention have a low melt portion which comprises either 100% of the binder fiber such that it is a low melting fiber, or a portion of the fiber is the low melt portion (such as bicomponent fibers). The low melt fiber and the low melt portion of the bicomponent fiber are made from polyolefin and are referred to as "base polyolefin". The low melt portion may consist of a metallocene catalyzed linear low-density polyethylene (mLLDPE) with an adhesion promoter.

[0018] The binder fibers of the present invention can also be base polyolefin with an adhesion promoter and an enhancement agent. Suitable base polyolefins may be high density polyethylene (HDPE), medium density polyethylene (MDPE), low density polyethylene (LDPE), linear low density polyethylene (LLDPE), ultra low density polyethylene (ULDPE), polypropylene (PP), or a mixture of these. These products are well known to those skilled in the art and are all commercially available from a wide variety of sources.

[0019] LLDPE resins are copolymers of ethylene and alpha-olefins with low alpha-olefin content. The higher the alpha-olefin content the lower the density of the resin. Metallocene catalyzed linear low density polyethylene (mLLDPE) is produced by Exxon Mobil under the trade name "EXCEED" and Dow Chemical under the trade name "AFFINITY". In contrast to LLDPE, produced with Ziegler-Natta catalysts, mLLDPE have a narrow molecular weight distribution and uniform composition distribution. Melting points of mLLDPE show a noticeable tendency on their composition and may very widely; for instance from 120°C for copolymers containing 1 ½ mole-% of alpha-olefin to 110°C for copolymers containing 3.5 mole-% alpha-olefin. In contrast, a LLDPE resin has a non-uniform compositional distribution. Melting such mixtures is dominated by the low branched fraction which is quite crystalline. As a result the melting points of LLDPE resins are not sensitive to copolymer composition and usually fall in the range of 125 to 128°C.

[0020] The adhesion promoters suitable for the present invention may be polyolefins grafted with maleic acid or maleic anhydride (MAH), both of which convert to succinic acid, succinic anhydride upon grafting to the polyolefin. The preferred incorporated MAH graft level is 10% by weight (by titration). Also, ethylene-acrylic copolymers, and a combination of this with the grafted polyolefins mentioned are suitable adhesion promoters. Commercially available maleic anhydride grafted polyethylenes are known as ASPUN resins from Dow Chemical. Commercially available ethylene-acrylic copolymers are Bynel 2022, Bynel 21E533 and Fusabond MC 190D or Fusabond C, both from DuPont, and the Escor acid terpolymers from ExxonMobil. The ethylene-acrylic copolymer comprises from about 1 to about 20% by weight based on the weight of the base polyolefin, and preferably from 5 to 15% by weight. The amount of grafted polyolefin adhesion promoter is such that the weight of incorporated maleic acid or maleic anhydride comprises from about 0.05% to about 2% by weight, and preferably from 0.1 to 1.5%.

[0021] The enhancement agent can comprise any of titanium dioxide (TiO_2), talc ($3\ MgO\text{-}4SiO_2.H_2O$), silica ($SiO_2$), alum ($Al_2\ (SO_4)_3$), calcium carbonate ($CaCO_3$), magnesia (MgO) and other oxides; titanium dioxide being preferred. The enhancement agent is employed in the polymer in an amount from about 0.1 to about 1% based on the weight of the base polyolefin. The particle size, in order to achieve good dispersion within the polymer and good spinnability is in the range of about 0.04 to about 5 μm, and preferably in the range of 0.05 to 2 μm.

[0022] Once the base polyolefin with adhesion promoter and any enhancement agent is produced, preferably by blending master batches to the base polyolefin, it is melt-spun into fiber as is known in the art. When a bicomponent fiber is employed as the binder fiber, the high melt portion may be selected from the class of polyolefins, such as polyethylene, polypropylene, and polybutylene; polyesters such as polyethylene terephthalate (PET), polybutylene terephthalate, polyethylene naphthalate, and the like; polyamides such as nylon 6, nylon 66; polyacrylates such as polymethacrylate, polymethylmethacrylate, and the like; as well as mixtures and copolymers thereof. Although the bicomponent fiber can be the side-by-side type or the sheath-core type, the sheath-core type is preferred, particularly where the low melt component is the sheath. The low melt portion of the bicomponent fiber can comprise from about

5% to about 75% by weight of said bicomponent fiber. Bicomponent fibers have an average length of from about 3 to 75 mm. Bicomponent fibers having a denier of between 1 and 10 are the preferred binder component.

[0023] Ignoring other components for a moment, suitable bicomponent fibers are polyethylene/polypropylene; polyethylene/polyester (especially polyethylene terephthalate); polyethylene/nylon, for example, as well as mixtures of these. Preferably polyethylene/polyester fibers, such as mLLDPE/PET or polyethylene/polypropylene, such as mLLDPE/PP are used. When both the low melt portion and the high melt portion of the bicomponent fiber contains polyolefins, the high melt polyolefin must have a melting point at least 5° C higher than the low melt polyolefin.

[0024] Suitable absorbents are natural or synthetic absorbents. Synthetic absorbents are primarily known as super absorbent polymers (SAP). The absorbents comprise 50 - 95 % by weight of the web. Natural absorbents are hydrophilic materials such as cellulosic fibers, wood pulp fluff, cotton, cotton linters, and regenerated cellulose fibers such as rayon, or a mixture of these. Preferred is wood pulp fluff, which is both inexpensive and readily available.

[0025] Absorbents do not absorb as much bodily fluid as when a portion of them has been replaced with synthetic fibers, and preferably polyester fibers, which provide loft to the composite. Providing loft to the composite exposes more surface area of the natural absorbents to the bodily fluids and thus they are much more efficient in absorbing the bodily fluid.

[0026] Absorbent pads employing natural absorbents may not provide adequate fluid intake for all circumstances. Also natural absorbents are very bulky. Accordingly, many absorbent pads employ SAP in relatively low quantities. This is because the cost of SAP is much higher than the cost of natural absorbents. Replacing some of the natural absorbents with SAP can reduce the overall bulk of the pad and/or provide superior fluid intake.

[0027] As used herein, the term "super absorbent polymer" or "SAP" refers to a water-swellable, generally water-insoluble material capable of absorbing at least about 10, desirably about 20, and preferably about 50 times or more its weight in water. The super absorbent polymer may be formed from organic material, which may include natural materials such as agar, pectin, and guar gum, as well as synthetic materials such as synthetic hydrogel polymers. Synthetic hydrogel polymers include, for example, carboxymethyl cellulose, alkali metal salts of polyacrylic acid, polyacrylamides, polyvinyl alcohol, ethylene maleic anhydride copolymers, polyvinyl ethers, hydroxypropyl cellulose, polyvinyl morpholinone, polymers and copolymers of vinyl sulfonic acid, polyacrylates, polyacrylamides, polyvinyl pyridine, and the like. Other suitable polymers include hydrolyzed acrylonitrile grafted starch, acrylic acid grafted starch, and isobutylene maleic anhydride copolymers and mixtures thereof. The hydrogel polymers are preferably lightly crosslinked to render the materials substantially water insoluble. Crosslinking may, for example, be effected by irradiation or covalent, ionic, van der Waals, or hydrogen bonding. Suitable materials are available from various commercial vendors such as the Dow Chemical Company, Allied Colloid, Inc., and Stockhausen, Inc. The super absorbent polymer may be in the form of particles, flakes, fibers, rods, films or any of a number of geometric forms.

[0028] Webs of the present invention can be made from either the dry laid or wet laid process. Dry laid webs are made by the airlay, carding, garneting, or random carding processes. Air laid webs are created by introducing the fibers into an air current, which uniformly mixes the fibers and then deposits them on a screen surface. The carding process separates tufts into individual fibers by combing or raking the fibers into a parallel alignment. Garneting is similar to carding in that the fibers are combed. Thereafter the combed fibers are interlocked to form a web. Multiple webs can be overlapped to build up a desired weight. Random carding uses centrifugal force to throw fibers into a web with random orientation of the fibers. Again multilayers can be created to obtain the desired web weight. Wet laid webs are made by a modified papermaking process in which the fibers are suspended in water, decanted on a screen, dried and bonded together.

[0029] The web of fibers can be bonded by thermal means. Thermal bonding utilizes an oven (hot air, radiant or microwave), or heated calendar roll(s), or ultrasonic energy. The web now has sufficient rigid structure to be useful as a component of an absorbent pad.

[0030] The absorbent is mixed with the binder fiber (base polyolefin, adhesion promoter, and enhancement agent) such that the binder fiber comprises from about 5 to about 25 percent of the total web, with the remainder being substantially the absorbent. The web compositions of the present invention can be layered until their weight is in the range from about 20 to about 500 grams per square meter (gsm, g/m^2), preferably from about 50 to about 250 gsm (g/m^2).

[0031] When a binder fiber or a suitable bicomponent fiber is employed in a mixture with the absorbent, an oven operating at a temperature sufficient to melt the low melt polymer fiber or the low melt portion of the bicomponent fiber must be employed. The web is then subjected to cooling conditions such that the binder fiber solidifies thus structurally locking the absorbent fibers to one another. Thereafter, the web may be cut into various lengths and widths for end use applications, namely, fenestration drapes, dental bibs, eye pads, diapers, incontinent pads, sanitary napkins, wound dressing pads, air filters, liquid filters and fabrics such as drapes, bedding or pillows.

TEST PROCEDURE

[0032] The melt point of the polymers tested hereunder is in accordance with the procedure of ASTM D3418-97, in a helium atmosphere.

[0033] The wet and dry strength of the web was measured according to TAPPI test methods T 456 om-87 and T 494 om-88 respectively. The wet strength was measured after an immersion time of 15 sec. The web strength was tested on a 25.4 x 203.2 mm strip for both the MD (machine direction) and CD (cross direction) with an Instron 1122 test machine. The tests were run at 127 mm original separation at a speed of 304.8 mm per minute. The strength is reported in units of g/25 mm.

[0034] Bonding Index is the square root of the product of the machine direction and cross direction strengths.

[0035] Intrinsic viscosity (IV) is measured in o-chlorophenol at 25° C using ASTM D4603-96.

Examples

[0036] In the following examples various bicomponent fibers were made with a core of 0.55 IV polyethylene terephthalate and a sheath of various compositions. The bicomponent fibers comprised a 50/50 core/sheath with the sheath being either LLDPE or mLLDPE. The LLDPE was obtained from Dow Chemical Company as ASPUN XU-61800.34 (Dow 34), and the mLLDPE was obtained from Dow Chemical Company as XU-58200.03 (Dow 03). The Dow 03 had a melting point of 108° C and the Dow 34 had a melting point of 128° C. Additives in a master batch were blended with the sheath polymer prior to fiber spinning. The bicomponent fibers, after being spun and drawn, were cut into 6mm lengths.

Example 1

[0037] Various 2.5 dpf (denier per filament) bicomponent fibers were made as shown in Table 1. The adhesion promoter was maleic anhydride (MAH) grafted polyethylene and was obtained from Dow Chemical as ASPUN XU 60769.07 (Dow 07) and added at the 10% level to give an incorporated MAH concentration of 0.1% in the sheath.

[0038] Nonwoven webs were made from these bicomponent fibers with a wet-lay process to give a basis weight of 90 g/m^2. The webs comprised 20% bicomponent fiber by weight and 80% wood pulp. The pulp type employed was Waco 416.

[0039] The web samples were bonded in a hot air oven at 143 or 166° C for 30 seconds. The bonding indices are shown in Table 1.

Table 1

Sheath	Bonding Temperature (° C)	Bonding Index (g/25 mm)
LLDPE	143	560
mLLDPE	143	962
LLDPE	166	707
mLLDPE	166	902

[0040] This illustrates that mLLDPE binder fibers, with an adhesion promoter, have higher web strengths than the prior art LLDPE sheath bicomponent fibers.

Example 2

[0041] 2 dpf fibers were prepared as in Example 1. Webs were prepared containing 10% bicomponent fibers with a basis weight of 100 gsm (g/m^2). The webs were bonded for 30 seconds at dryer temperatures of 115, 140 and 165° C. The results are set forth in Table 2.

Table 2

Sheath	Bonding Temperature (°C)	Bonding Index (g/25 mm)
LLDPE	115	157
mLLDPE	115	376

Table 2 (continued)

Sheath	Bonding Temperature (°C)	Bonding Index (g/25 mm)
LLDPE	140	437
mLLDPE	140	448
LLDPE	165	508
mLLDPE	165	444

[0042] This data is graphed in Figure 1, and illustrates the broad bonding window with mLLDPE compared to the prior art LLDPE.

Example 3

[0043] The mLLDPE bicomponent fibers of Example 2 were formed into a web using an air laid process. The web contained 12% bicomponent fibers and has a basis weight of 250 gsm (g/m^2). Thermo-tapes were placed on the top and bottom of the web. These indicated the actual web temperature that the top and bottom of the web had experienced in the bonding oven. Bonding set temperatures of 145 and 165° C were used. The difference in the actual web temperatures from the set temperature is given in Table 3.

Table 3

Bonding temperature (° C)	Top temperature (° C)	Bottom temperature (° C)
145	-9	-17
165	-9	- 29

[0044] This illustrates the value of a binder fiber that has both a lower and broader bonding window (see Figure 1). The full thickness of the web is fully bonded by the use of a binder fiber with a broad bonding window, such as mLLDPE fibers with an adhesion promoter, giving optimum z-directional strength at low bonding temperatures.

Example 4

[0045] The mLLDPE bicomponent fibers of Example 2 were formed into a web using an air laid process. The web contained 12% bicomponent fibers and has a basis weight of 175 gsm (g/m^2). In addition a bicomponent fiber was prepared without an adhesion promoter, only the mLLDPE sheath. The webs were bonded with a set temperature of 155° C for 17 seconds. The bonding indices are set forth in Table 4.

Table 4

Sheath	Bonding Index, dry (g/25 mm)	Bonding Index, wet (g/25 mm)
mLLDPE	217	171
mLLDPE + 0.1% MAH	1493	789
LLDPE + 0.1% MAH	816	350

[0046] This shows the need for an adhesion promoter and the superior bonding index of mLLDPE binder fibers containing an adhesion promoter compared to prior art..

Example 5

[0047] Bicomponent fibers, 2 dpf, were prepared containing 0.7% TiO_2 in the 50% sheath and compared to LLDPE fibers not containing an enhancing agent. All sheaths contained 0.1 weight % incorporated MAH. These bicomponent fibers were formed into an 85 gsm (g/m^2) web using a wet laid process at the 20% level, bonded with an oven set point of 150° C for 50 seconds. The bonding indices of these webs are set forth in Table 5.

Table 5

Sheath	Bonding Index (g/25 mm)
LLDPE	972
LLDPE + TiO_2	1966
mLLDPE + TiO_2	2070

[0048] This illustrates the surprising increase in bonding index for both LLDPE and mLLDPE binder fibers (containing an adhesion promoter) with the addition of an inorganic particle enhancing agent such as TiO_2.

[0049] While not wishing to be bound by any theory, it is believed that the presence of small inorganic particles on the surface of the binder fiber improves the dispersion of the fibers during the web formation process. This yields a more uniform distribution of fibers through the web and a higher bonding index.

[0050] Thus it is apparent that there has been provided, in accordance with the invention, a binder fiber containing a metallocene catalyzed polyethylene (mPE) and an adhesion promoter; and a web made therefrom; binder fiber containing polyethylene, an adhesion promoter, and an enhancement agent; and a web made therefrom, that fully satisfies the objects, aims, and advantages set forth above.

Claims

1. A binder fiber comprising: a metallocene catalyzed linear low density polyethylene (mLLDPE) and an adhesion promoter.

2. The binder fiber of claim 1, wherein said adhesion promoter is selected from the class of maleic acid or maleic anhydride grafted polyolefin, ethylene-acrylic copolymers, or a combination of these.

3. The binder fiber of claim 2, wherein said grafted polyolefin contains incorporated maleic acid or maleic anhydride in the range from 0.05 to 2.0 weight % of said mLLDPE.

4. The binder fiber of claim 2, wherein said ethylene-acrylic copolymers are present in a range of 1 to 20 weight % of said mLLDPE.

5. The binder fiber of one of claims 1 to 4, wherein said binder fiber is low melting fiber, bicomponent fiber, or both.

6. The binder fiber of claim 5, wherein said bicomponent fiber has a low melting portion and a high melting portion, said low melting portion is said mLLDPE, and said high melting portion is selected from the class of polyolefin, polyester, polyamide, polyacrylates, or a combination of two or more of these.

7. The binder fiber of claim 6, wherein said high melting portion comprises polyester.

8. The binder fiber of claim 6, wherein said high melting portion comprises polyolefin.

9. The binder fiber of one of claims 1 to 8, wherein said mLLDPE has a melting point below 120° C as determined by ASTM D3418-97.

10. The binder fiber of one of claims 6 to 9, wherein said low melting portion comprises from 5 to 75 weight % of said bicomponent fiber.

11. A binder fiber comprising: a base polyolefin, an adhesion promoter, and an enhancement agent, said base polyolefin is low melting fiber, the low melting portion of bicomponent fiber, or both.

12. The binder fiber of claim 11,wherein said base polyolefin is selected from the class of polypropylene, high density polyethylene (HDPE), medium density polyethylene (MDPE), low density polyethylene (LDPE), linear low density polyethylene (LLDPE), and ultra low density polyethylene (ULDPE).

13. The binder fiber of claim 12, wherein said base polyolefin is metallocene catalyzed polyolefin.

14. The binder fiber of one of claims 11 to 13, wherein said enhancement agent is selected from the class of titanium dioxide, talc, silica, alum, calcium carbonate, calcium oxide, and magnesium oxide.

15. The binder fiber of one of claims 11 to 14, wherein said enhancement agent is in powder form in a range of 0.04 to 5 microns.

16. The binder fiber of one of claims 11 to 15, wherein said adhesion promoter is selected from the class of maleic acid or maleic anhydride grafted polyolefin, ethylene-acrylic copolymers, or a combination of these.

17. The binder fiber of claim 16, wherein said grafted polyolefin contains incorporated maleic acid or maleic anhydride in the range from 0.05 to 2.0 weight % of said base polyolefin.

18. The binder fiber of claim 16, wherein said base polyolefin contains 1 to 20 weight % of said ethylene-acrylic copolymers.

19. The binder fiber of one of claims 11 to 18, wherein said binder fiber contains from 0.1 to 1 weight % of said enhancement agent based on said base polyolefin.

20. The binder fiber of one of claims 11 to 19, wherein said bicomponent fiber has a high melting portion, said low melting portion is said base polyolefin, and said high melting portion is selected from the class of polyolefin, polyester, polyamide, polyacrylates, or a combination of two or more of these.

21. The binder fiber of claim 20, wherein said high melting portion comprises polyester.

22. The binder fiber of claim 20, wherein said high melting portion comprises polyolefin.

23. A web comprising a binder fiber according to one of claims 1 to 10.

24. A web comprising a binder fiber according to one of claims 11 to 22.

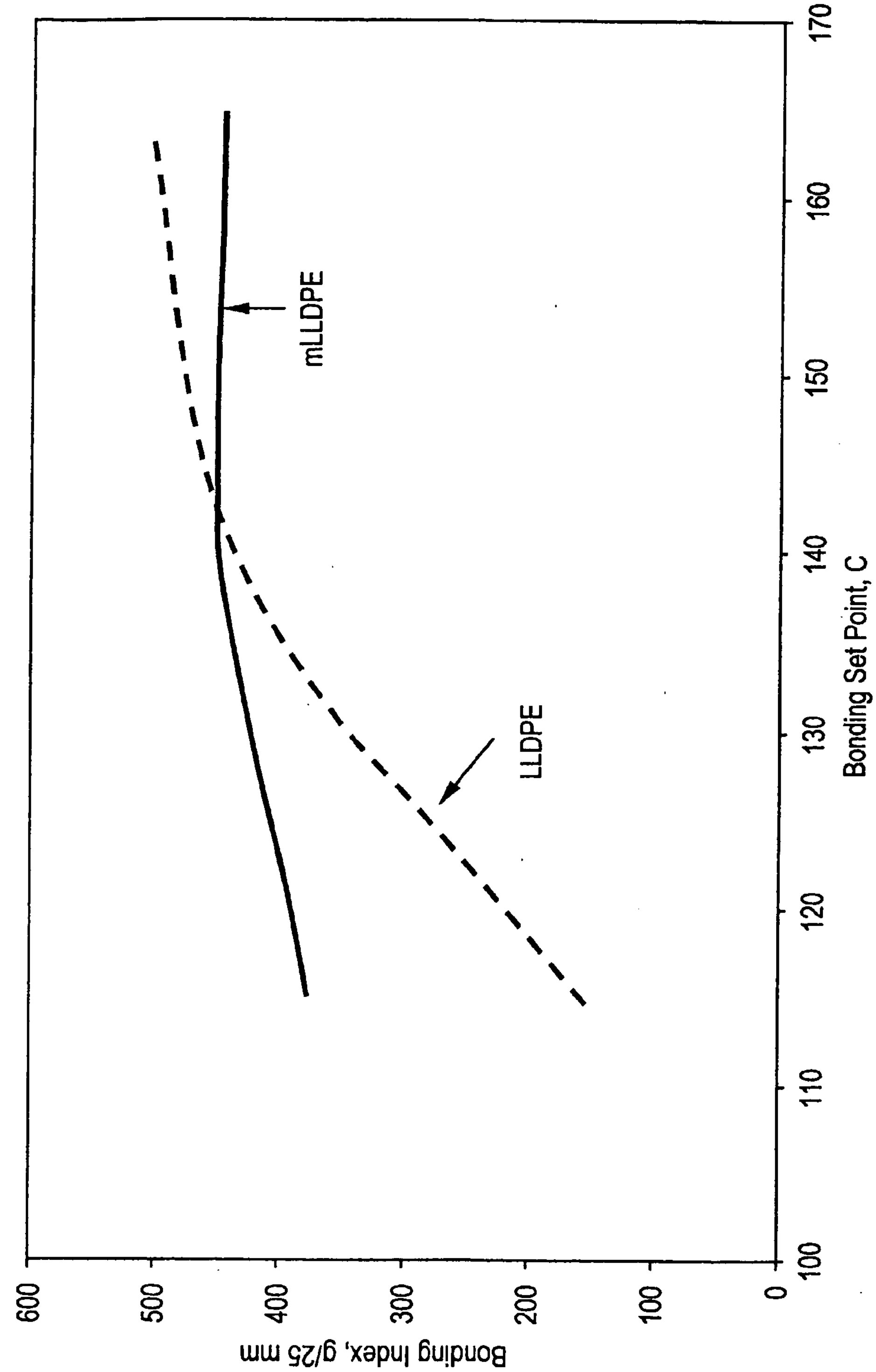
25. The web of claim 23, further comprising an absorbent.

26. The web of claim 24 further comprising an absorbent.

27. The web of claim 25, said web having a dry bonding index which is at least 10% greater than that of a web which is prepared from LLDPE (instead of mLLDPE) at bond temperatures between 120 - 160°C.

28. The web of claim 25 or 26, wherein said absorbent comprises natural absorbents, super absorbent polymer, or both; and said absorbent comprises from 75 to 95 weight % of said web.

FIG. 1


mLLDPE
LLDPE
Bonding Index, g/25 mm
600
500
400
300
200
100
0
Bonding Set Point, C
100
110
120
130
140
150
160
170

European Patent Office

EUROPEAN SEARCH REPORT

Application Number
EP 03 00 6296

DOCUMENTS CONSIDERED TO BE RELEVANT

Category	Citation of document with indication, where appropriate, of relevant passages	Relevant to claim	CLASSIFICATION OF THE APPLICATION (Int.Cl.7)
Y	EP 0 465 203 A (HOECHST CELANESE CORP) 8 January 1992 (1992-01-08) * page 4, line 6-65 - column P *	1	D01F8/00 D01F8/14 D04H1/00 D04H13/00 A61F13/00
Y	WO 00 29655 A (KIMBERLY CLARK CO) 25 May 2000 (2000-05-25) * page 10 *	1	
X	US 5 372 885 A (TABOR RICKY L ET AL) 13 December 1994 (1994-12-13) * column 5, line 46 - column 6, line 68 *	11	
X,P	EP 1 241 284 A (BP CHEMICALS SNC) 18 September 2002 (2002-09-18) * column 2, line 10 - column 4, line 45 *	11	
X	US 5 981 410 A (HANSEN PIA HOLM ET AL) 9 November 1999 (1999-11-09) * column 2, line 63 - column 4, line 5 *	11	
A	US 4 950 541 A (TABOR RICKY L ET AL) 21 August 1990 (1990-08-21) * the whole document *	1-28	TECHNICAL FIELDS SEARCHED (Int.Cl.7)
A	US 5 635 262 A (BEST STEVEN A ET AL) 3 June 1997 (1997-06-03) * the whole document *	1-28	D01F D04H A61F
A	US 4 927 888 A (STRAIT CHAD A ET AL) 22 May 1990 (1990-05-22) * the whole document *	1-28	

The present search report has been drawn up for all claims

Place of search	Date of completion of the search	Examiner
MUNICH	14 August 2003	Lanniel, G

CATEGORY OF CITED DOCUMENTS

X : particularly relevant if taken alone
Y : particularly relevant if combined with another document of the same category
A : technological background
O : non-written disclosure
P : intermediate document

T : theory or principle underlying the invention
E : earlier patent document, but published on, or after the filing date
D : document cited in the application
L : document cited for other reasons

& : member of the same patent family, corresponding document

EPO FORM 1503 03.82 (P04C01)

ANNEX TO THE EUROPEAN SEARCH REPORT ON EUROPEAN PATENT APPLICATION NO. EP 03 00 6296

This annex lists the patent family members relating to the patent documents cited in the above-mentioned European search report.
The members are as contained in the European Patent Office EDP file on
The European Patent Office is in no way liable for these particulars which are merely given for the purpose of information.

14-08-2003

Patent document cited in search report		Publication date	Patent family member(s)			Publication date
EP 0465203	A	08-01-1992	US	5167765	A	01-12-1992
			AT	135419	T	15-03-1996
			CA	2045114	A1	03-01-1992
			DE	69117821	D1	18-04-1996
			DE	69117821	T2	12-09-1996
			EP	0465203	A1	08-01-1992
			JP	2096880	C	02-10-1996
			JP	4241193	A	28-08-1992
			JP	7111039	B	29-11-1995
			MX	9100053	A1	28-02-1992
			US	5167764	A	01-12-1992
WO 0029655	A	25-05-2000	US	6589892	B1	08-07-2003
			AU	1464800	A	05-06-2000
			WO	0029655	A1	25-05-2000
US 5372885	A	13-12-1994	US	4950541	A	21-08-1990
			AU	584910	B2	08-06-1989
			AU	4560485	A	20-02-1986
			BR	8503861	A	27-05-1986
			DK	352485	A	16-02-1986
			EP	0171777	A2	19-02-1986
			FI	853137	A	16-02-1986
			JP	61081447	A	25-04-1986
			KR	9105563	B1	31-07-1991
			NO	853200	A	17-02-1986
			NZ	213048	A	26-04-1989
			US	5066542	A	19-11-1991
			US	4684576	A	04-08-1987
EP 1241284	A	18-09-2002	EP	1241284	A1	18-09-2002
			WO	02072934	A1	19-09-2002
US 5981410	A	09-11-1999	AU	6918298	A	30-10-1998
			BR	9809749	A	20-06-2000
			CN	1106469	B	23-04-2003
			DE	69808061	D1	24-10-2002
			DE	69808061	T2	14-08-2003
			WO	9845519	A1	15-10-1998
			DK	973966	T3	27-01-2003
			EP	0973966	A1	26-01-2000
			JP	2001518986	T	16-10-2001
			TW	436535	B	28-05-2001
US 4950541	A	21-08-1990	WO	9001504	A1	22-02-1990
			US	4762890	A	09-08-1988

EPO FORM P0459

For more details about this annex : see Official Journal of the European Patent Office, No. 12/82

ANNEX TO THE EUROPEAN SEARCH REPORT ON EUROPEAN PATENT APPLICATION NO. EP 03 00 6296

This annex lists the patent family members relating to the patent documents cited in the above-mentioned European search report.
The members are as contained in the European Patent Office EDP file on
The European Patent Office is in no way liable for these particulars which are merely given for the purpose of information.

14-08-2003

Patent document cited in search report	Publication date	Patent family member(s)	Publication date
US 4950541 A		US 5372885 A	13-12-1994
		AU 642848 B2	04-11-1993
		DE 3855900 D1	12-06-1997
		DE 3855900 T2	11-09-1997
		EP 0428510 A1	29-05-1991
		JP 2666080 B2	22-10-1997
		JP 4505165 T	10-09-1992
		KR 182607 B1	15-05-1999
		US 4927888 A	22-05-1990
		US 5089556 A	18-02-1992
		US 4966810 A	30-10-1990
US 5635262 A	03-06-1997	AT 177460 T	15-03-1999
		CA 2208232 A1	20-06-1996
		DE 69508278 D1	15-04-1999
		DE 69508278 T2	30-09-1999
		EP 0797622 A1	01-10-1997
		WO 9618678 A1	20-06-1996
US 4927888 A	22-05-1990	US 4762890 A	09-08-1988
		US 4966810 A	30-10-1990
		US 4950541 A	21-08-1990
		US 5089556 A	18-02-1992

EPO FORM P0459

For more details about this annex : see Official Journal of the European Patent Office, No. 12/82